Incorporating Building Electrification - Fuel Substitution in the Forecast

DAWG Meeting June 23, 2021

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CEC - EAD

In Broad Strokes…

What was included in 2019?

- Used a “what-if” percentage of all electric new construction in 2019 Additional Achievable Energy Efficiency (AAEE)

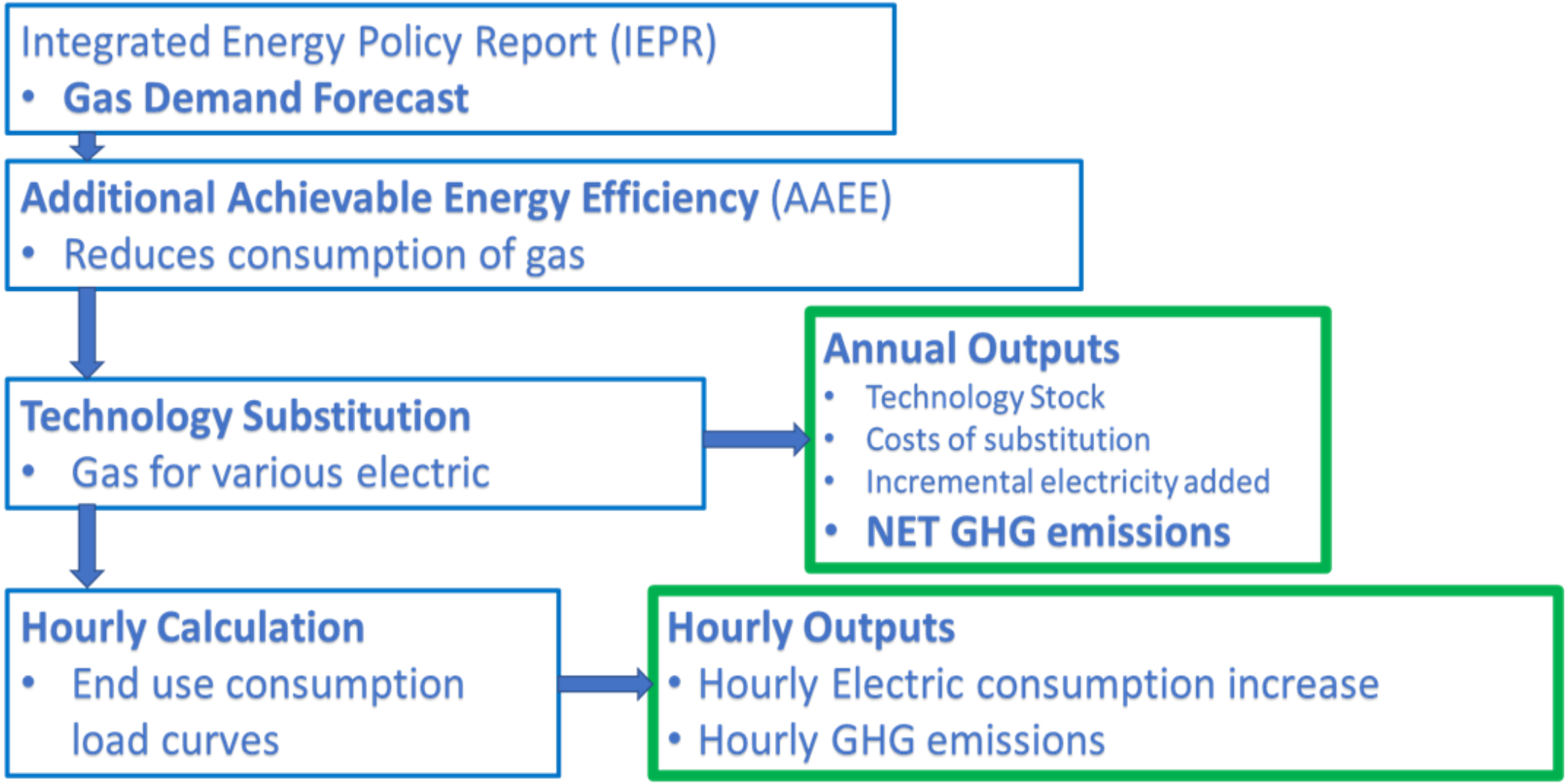
- Used **low** for AAEE 1&**2**, **mid** AAEE **3**&4, high AAEE 5&6
  - **Low**: Assumed all electric penetration rate of 0.5% per year beginning 2020, ramping linearly to a cumulative of **5.5%** in 2030
  - **Mid**: Assumed all electric penetration rate of 1.5% per year beginning 2020, ramping linearly to a cumulative of **16.5**% in 2030
  - High: Assumed all electric penetration rate of 2.5% per year beginning in 2020, ramping linearly to a cumulative of 27.5% in 2030

What work has EAD done since then?

- Developed “what-if” Fuel Substitution Scenario Analysis Tool (FSSAT)

- Used the FSSAT to analyze building electrification scenarios in our AB 3232 Analysis described in the recently published California Building Decarbonization Assessment

Modeling electrification: Fuel Substitution Scenario Analysis Tool (FSSAT) main processes flow chart



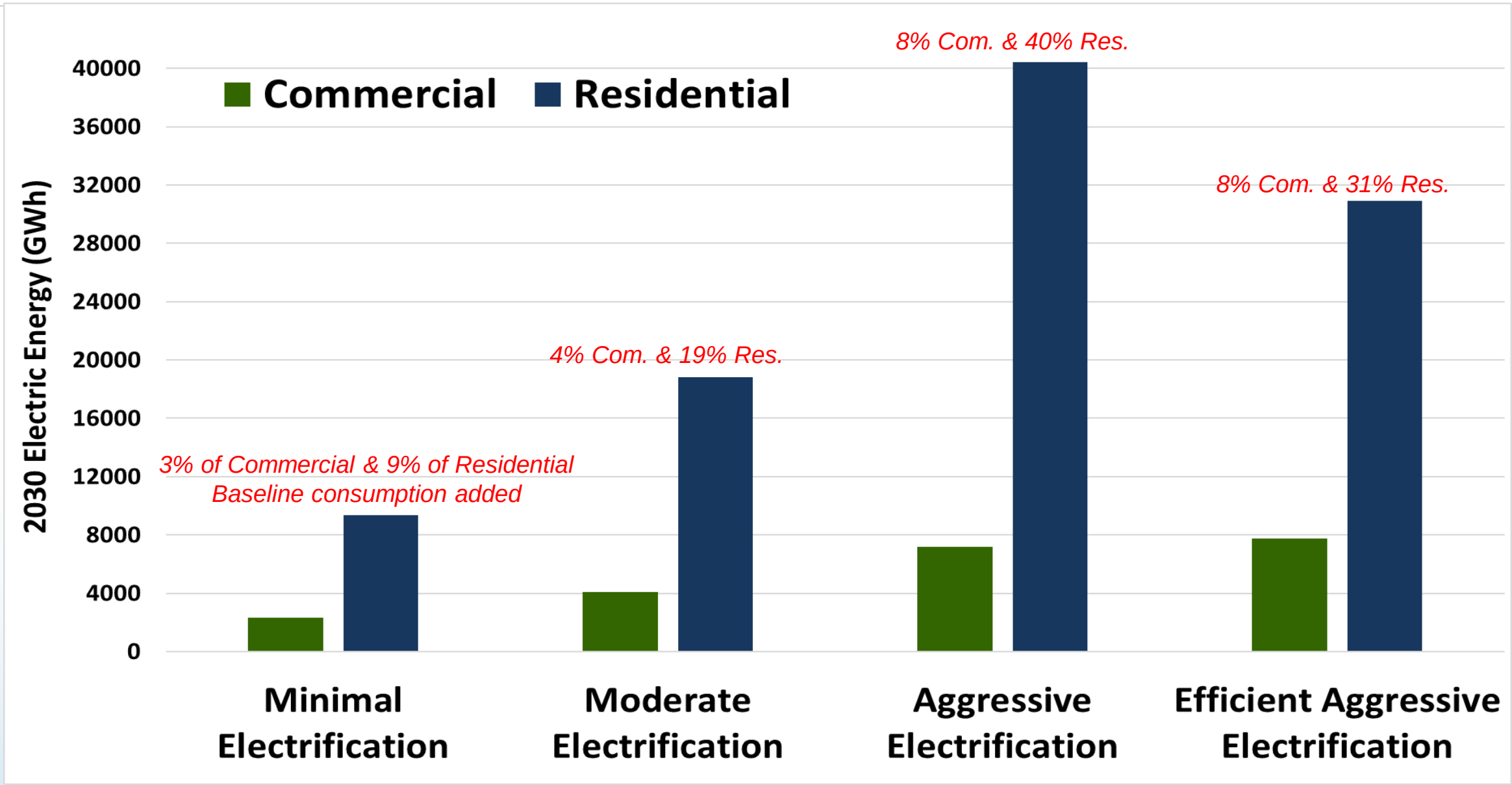
Building end-use electrification scenarios:
Minimal, Moderate, Aggressive, Efficient Aggressive

<table>
<tr><th>Electrification Scenario Using FSSAT</th><th>New Construction (NC)</th><th>Replace on Burnout (ROB)</th><th>Early Replacement (RET)</th><th>Technology Efficiency</th><th>SB 1383 Goals Toggle</th></tr>
<tr><td>Minimal</td><td rowspan="4">100% by 2030</td><td>15%</td><td rowspan="2">5%</td><td rowspan="3">High-Efficiency Weighted Mix</td><td rowspan="4">Potential of reducing 7.5 MMTCO$_2$e of HFC Leakage in 2030</td></tr>
<tr><td>Moderate</td><td>50%</td></tr>
<tr><td>Aggressive</td><td rowspan="2">90%</td><td rowspan="2">70%</td></tr>
<tr><td>Efficient Aggressive</td><td>Single-Best Efficiency</td></tr>
</table>

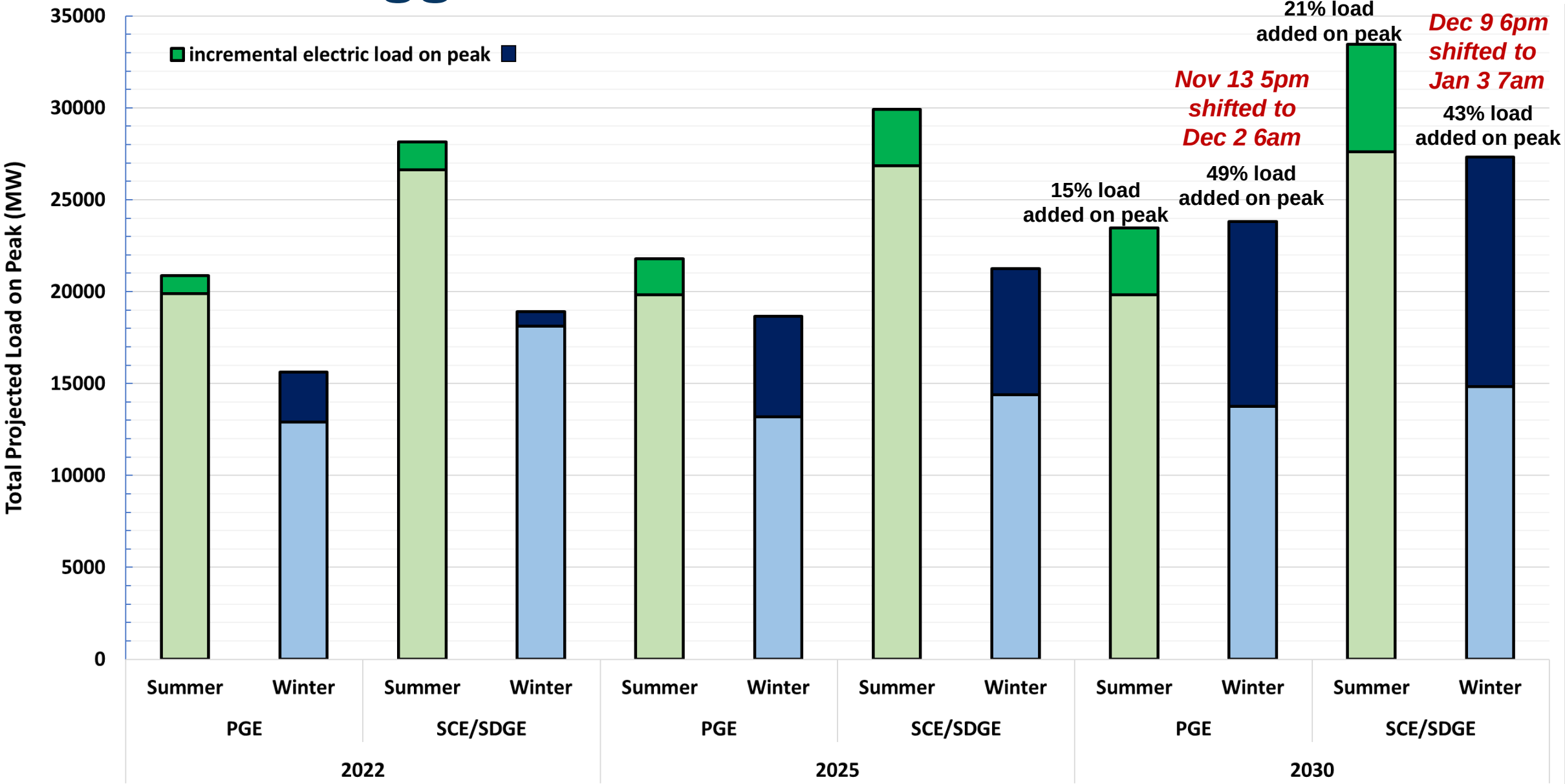
Where:

- NC, ROB, and RET are percentages of eligible technologies by sector/end-use that will be electric in 2030
- The Minimal electrification scenario just meets the 40-percent AB 3232 target
- The impacts of the SB 1383 toggle are external to the FSSAT framework

Statewide Annual Incremental Electricity Demand by Scenario-Specific Electrification in 2030



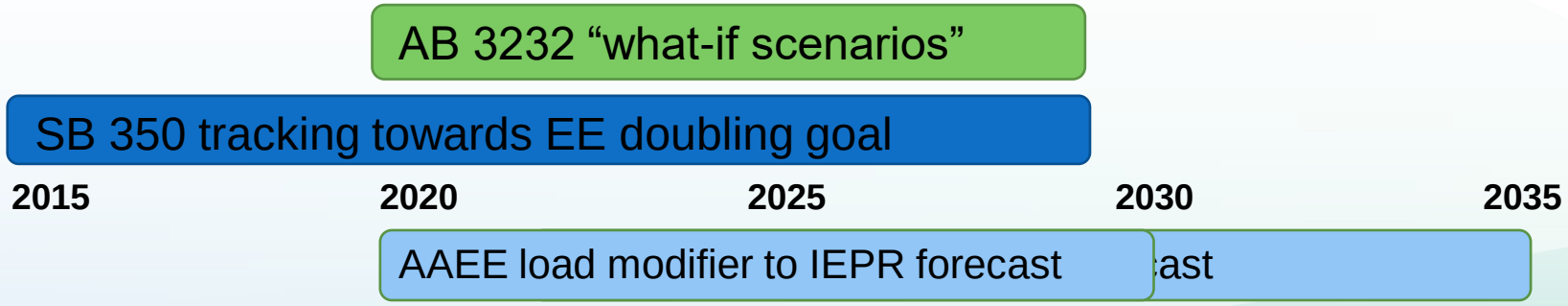
Summer and Winter Peak Load Impacts after Aggressive Electrification



EAD Decarbonization Analysis to be updated for 2021 IEPR

- Energy Efficiency (EE) tracking and projection/forecast scenarios
  - Incorporate new data such as from utility and other incentive programs to update historical savings as improve projections
  - Add new EE programs savings projections
  - Incorporate updates to code and standards in savings projections
  - Consider overlap in customer segments being targeted by different programs
  - Consider market-based activities that may result in EE savings that are not being captured elsewhere

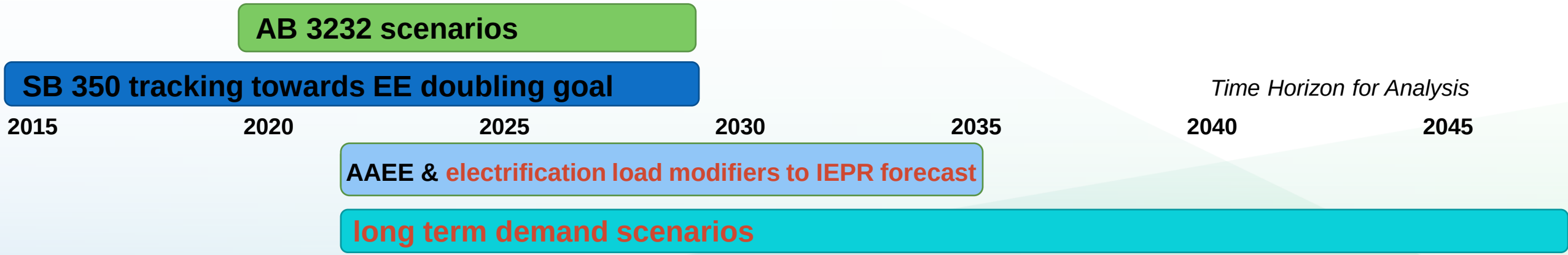
- Building Electrification - Fuel Substitution projections…



Time Horizon for Analysis

NEW EAD Decarbonization Analysis for 2021 IEPR

- Energy Efficiency (EE) tracking/projections and hourly forecast load modifier
- Building Electrification tracking/projections and hourly forecast load modifier
  - ***Varying time horizons***
  - ***Varying uncertainties***
  - ***Varying uses***
- New long term demand scenarios are being developed to complement the traditional 10-year gas and electricity demand forecast used for energy planning and procurement purposes and may help inform future policy decisions towards California's mid-century climate goals.



History for context & guidance

Compare to AAEE

- ***For 2021 we wish to develop Additional Achievable Fuel Substitution (AAFS) as an hourly load modifier to the baseline demand forecast.***

- AAFS is conceptualized as separate from AAEE
- We wish to use a manner similar to the one which was developed for AAEE for AAFS; ie. a “template”

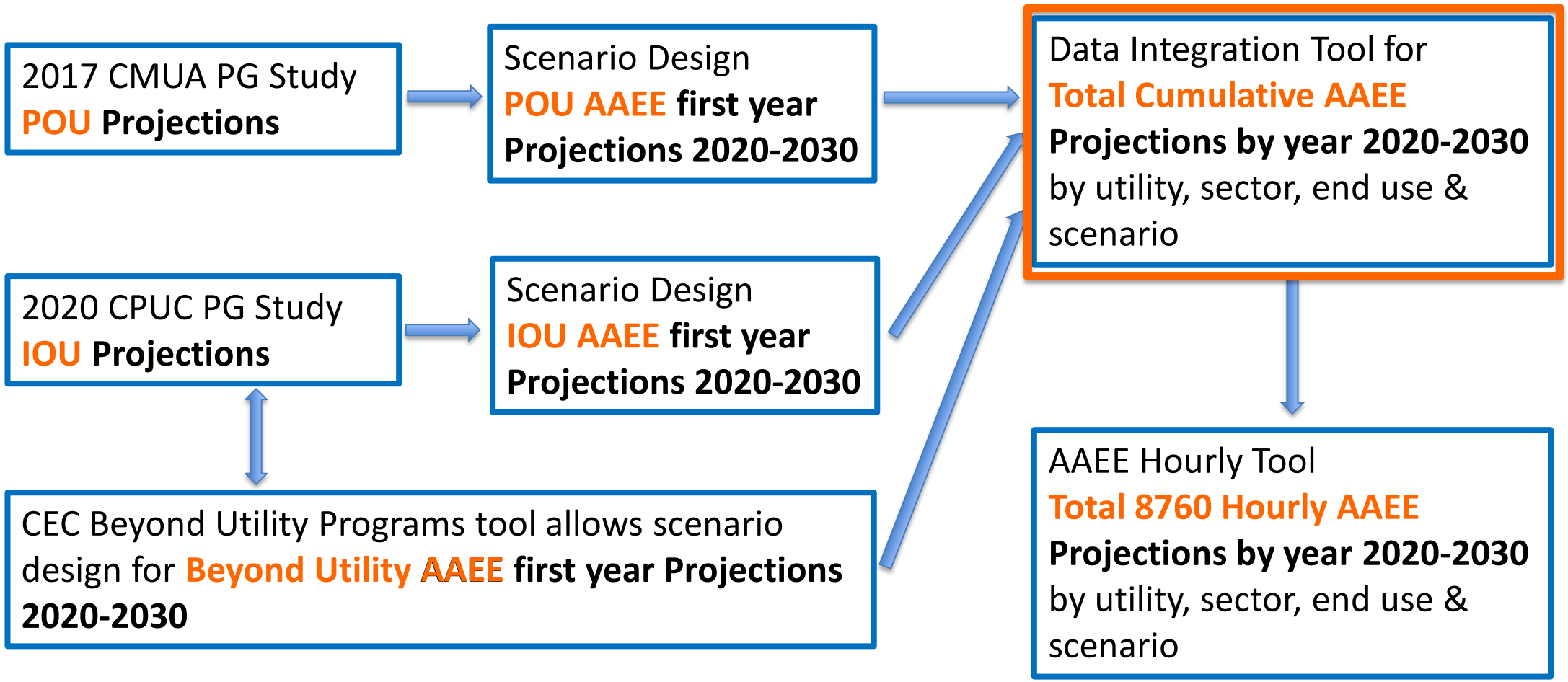
Step back and look at the genesis of AAEE…

2009	Initial CEC analysis of "incremental, uncommitted" EE savings for use in developing managed demand forecast
2010	CPUC staff adjusts 2009 IEPR baseline demand forecast with Mid-Case "incremental, uncommitted" EE savings for use in 2010 LTPP assessments
2011	ISO assesses CEC-prepared "incremental, uncommitted" energy efficiency savings mid case as a sensitivity analysis in 2011-12 TPP
2011	CEC plans to include "incremental, uncommitted" EE savings adjustments to baseline forecast to create adopted managed demand forecasts in 2012 IEPR Update
2012	Back and forth between CEC and CPUC about how to use "incremental, uncommitted" EE in conjunction with variations of the baseline demand forecast
2012	CEC provides load bus impacts of "incremental, uncommitted" EE savings to ISO for use in power flow modeling for inter-agency AB 1318 study
2013	CEC provides "incremental, uncommitted" EE savings by load bus to ISO for use in 2013-14 TPP power flow modeling
2013	Discussions among CEC, CPUC, and ISO about "single forecast set" language
2013	CPUC staff analysis showing EE impacts within SCE service area
2014	Letter to legislature outlining "single forecast set" language

Single Managed Forecast Set

- *"Energy Commission, in consultation with the CPUC and the CAISO, considered public input in selecting a single or managed demand forecast from the adopted forecast report for use in transmission planning and procurement. This set of forecast numbers is a combination of two forecast components: a base case with weather variants and an additional achievable energy efficiency (AAEE) scenario. Combined together, these create the single or managed forecast."*
- **Three baseline cases and five scenarios of AAEE**
- The mid-AAEE forecast scenario will be used for system-wide and flexibility studies relied upon for procurement and transmission planning purposes.
- Because of the local nature of reliability needs and the difficulty of forecasting locally disaggregated AAEE, the low-mid-AAEE scenario will be used for local studies.

Additional Achievable Energy Efficiency (AAEE)
2019 Process Flow Overview



Scenario Development for 2019 AAEE

Source	Lever		High - Low (Scenario 1)	Mid - Low (Scenario 2)	Mid - Mid (Scenario 3)	Mid - High (Scenario 4)	Low - High (Scenario 5)	Mid - High Plus (Scenario 6)
2017 IEPR	Building Stock		2017 IEPR High-Case	2017 IEPR Mid-Case	**2017 IEPR Mid-Case**	2017 IEPR Mid-Case	2017 IEPR Low-Case	2017 IEPR Mid-Case
	Retail Prices							
Navigant & CEC Processing of 2020 PG Study	AIMS ETs		Reference		**Reference**	Average of Reference & Aggressive		Aggressive
	Incentive Levels		capped at 25% of incremental cost	capped at 50% of incremental cost	**capped at 50% of incremental cost**	capped at 50% of incremental cost		capped at 75% of incremental cost
	C-E Measure Screening Threshold (TRC using 2019 Avoided Costs)		1		1			0.65
	Marketing & Outreach		Default calibrated value		**Default calibrated value**	Increased marketing/outreach		
	Financing Programs		No modeled impacts		**No modeled impacts**	IOU financing programs broadly available to Res and Com customers		
	Low Income		PG Study Result Unchanged		**PG Study Result Unchanged**	PG Study Result Unchanged		
	BROs Program Assumptions		Reference		**Reference**	Average of Reference & Aggressive		Aggressive
Navigant & CEC Processing of 2020 PG Study AND CEC Processing of WA#2 Results for BU Programs WB	Title 24	Compliance Reduction or Enhancement	no additional included	20% Compliance Rate Reduction	**Reference Case Compliance**	Compliance Enhancements		
		Code Cycles (Vintages)		2022 Nonresidential New Construction and A&A; 2022 Residential A&A *BUWB*			same scope through 2025 Standards *BU WB*	same scope through 2028 Standards *BU WB*
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		Code Cycles (Vintages)		Selected Stds through 2022 *PG Study*	**Selected Stds through 2022** *PG Study*	Selected Stds through 2022 *PG Study*	Selected Stds through 2025	*PG Study & BU WB*
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		Code Cycles (Vintages)			**through 2023 (excluding 2020 GSL Std) + 2026 Water Source Heat Pump** *PG Study*	through 2023 (excluding 2020 GSL Std) + 2026 Water Source Heat Pump *PG Study & BU WB*	through 2023 + 2026 Water Source Heat Pump (including 2020 GSL Std expanded scope) *PG Study & BU WB*	all through 2026 Water Source Heat Pump + selected standards through 2030 *PG Study & BU WB*
CEC Processing of WA#2 Results for BU Programs WB	Prop 39		**mid**: established programs with historical performance data and expected future funding allocations				high	
	DGS Energy Retrofit							
	ECAA Financing							
	GGRF: Water Energy Grant							
	GGRF: Low Income Weatherization							
	Local Government Ordinances		low		**mid**: limited historical data on a pilot or other subset of programs and reasoned assumption on future funding allocations			
	PACE Financing							
	Benchmarking and Public Disclosure							
	Fuel Substitution							
	Behavioral, Retrocommissioning, Operational Savings		not included				low	**mid**: assumptions based on pilot or proposed programs
	Local Government Challenge							
	Energy Asset Rating							
	Smart Meter Data Analytics							
	Air Quality Management District		not included					**mid**: limited assumptions based on pilot or proposed programs
	Agricultural							
	Industrial							
	Conservation Voltage Reduction							
CEC Processing of WA#1 Results based on 2017 CMUA PG Study	Expand Measure List		Reference		Reference	Add new measures		
	Incentive Level		Reference x 75%			Reference		
	Promotional Expenditures					Reference x 125%		
	Behavioral Programs		Remove newly planned IOU			Reference		
	Early Retirement Programs		Reference			Implement Programs		
	IOU or POU Net to Gross		IOU					
	Re-participation Rates							

IOU Potential Program Savings

Codes and Standards Savings

Beyond Utility Program Savings

POU Potential Program Savings

Diving into the Deep End

Scenario Development for 2021 AAFS

CEC is not at the stage where we are ready to make recommendations, but we are attempting to come to a common understanding of what we need to explore.

The next step would be defining a mutually agreed upon process for incorporating building electrification into the IEPR Demand Forecast such that it is useful to the joint agencies and their stakeholders.

Scenario Development for 2021 AAFS

- Desire is to eventually create a parallel scenario structure for AAFS to AAEE
- Considerable uncertainties to consider in the current state
  - SB 350 allows for Fuel Sub to count as EE
  - 2021 draft PG Study does not include much FS
    - May change if “refreshed” with the 2021 ACC
- Previous work has shown that we may expect a drastic change to the forecast in high electrification scenarios
  - ie. such as winter peaking loads

Proposal for 2021 AAFS Development

Elements to be included in AAFS

Potential AAFS data sources for scenario creation

(different level of stringency for each, which have their own level of uncertainty)

- 2021 PG Study measures
- ★Local ordinances
  encouraging electrification of some or all end-uses as well as local natural gas bans
- 2022 Building Standards
  proposing all electric baselines for prescriptive compliance for new construction
- POU data on recent fuel substitution activities
  (especially SMUD, LADWP, Palo Alto)
- IOU data (CEDARS) on recent fuel substitution activities
- BUILD/TECH programs being rolled out per SB 1477
- Programs operating outside of Utility EE Portfolios
  (ex. SCE San Joaquin program electrifying propane)
- Incorporate transportation electrification
  (Governor's E.O. banning sales of new ICE in 2035)

Example Element: Local Ordinances

Natural Gas Bans and REACH Codes Residential Housing Share Affected (2015- 2019 Construction Data)							
Housing Type/End-Use Constraints	**Statewide**	**PGE**	**SMUD**	**SCE**	**LADWP**	**SDGE**	**OTHER**
Single Family							
Total Units	*53406*	*17039*	*3146*	*14453*	*2317*	*2581*	*727*
% All End-uses electric	**5.14%**	**8.10%**	**40.14%**	**0.10%**	0%	0%	0%
% All except cook & fire	**0.28%**	**0.87%**	0%	0%	0%	0%	0%
% WH only	**0.38%**	0%	0%	0%	0%	**1.19%**	0%
% Other	**0.01%**	**0.03%**	0%	0%	0%	0%	0%
Multi-family							
Total Units	*55370*	*19077*	*1378*	*12397*	*12490*	*6194*	*682*
% All End-uses electric	**21.10%**	**55.88%**	**69.50%**	0%	0%	0%	0%
% All except cook & fire	**0.58%**	**1.67%**	0%	0%	0%	0%	0%
% WH only	**0.24%**	0%	0%	0%	0%	**2.18%**	0%
% Other	**0.05%**	**0.14%**	0%	0%	0%	0%	0%

Proposal for 2021 AAFS Development
Elements to be included in AAFS

Potential AAFS data sources for scenario creation
(different level of stringency for each, which have their own level of uncertainty)

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Proposal for 2021 AAFS Development
Elements to be included in AAFS

Question:

- **Any additional FS elements we might be missing and should consider including?**

Proposal for 2021 AAFS Development
Possible approach to Scenarios

- AB 3232 analysis based on “what if”; can’t use AB 3232 scenarios as a starting point for AAFS
- We are working on incorporating more program-oriented inputs for a “new and improved” FSSAT
- As in the 2019 AAEE forecast, and before, the objective is to continue to focus on firm programs and projections since the core scenarios will be used for planning and procurement purposes
- As in previous iterations, develop variations around these most probable futures to show other possible outcomes given less or more effort input to realize the potential of existing or proposed EE and FS programs

Proposal for 2021 AAFS Development
Possible approach to Scenarios

Preliminary thoughts on what could go into a hypothetical set of AAFS scenarios 1-6 ranging from most conservative to most aggressive or optimistic

"Firm commitments" including only anticipated all electric new construction due to currently existing local ordinances and existing Utility programs with compliance rates, participation, and funding ratcheted down from standard values.

Add all electric new construction as expected to be encouraged by the proposed T24 update to the below.

“Firm commitments”

The below using standard values for compliance rates, participation, and funding plus the addition of some firmer funded programs such as BUILD/TECH.

new construction as expected from the proposed T24

“Firm commitments”

Ratchet all of the below elements up beyond standard values for compliance rates, participation, and funding.

addition of some firmer funded programs such as BUILD/TECH

new construction as expected from the proposed T24

“Firm commitments”

A scenario which includes the below and adds more speculative programs in order to meet minimum AB 3232 goals for the Residential and Commercial Sector.

Ratchet all of the below elements up beyond standard values for compliance rates, participation, and funding.

addition of some firmer funded programs such as BUILD/TECH

new construction as expected from the proposed T24

“Firm commitments”

A scenario which includes the below and expands speculative programs further to meet economywide mid-century GHG reduction goals.

Add more speculative programs to meet minimum AB 3232 goals

Ratchet all of the below elements up beyond standard values for compliance rates, participation, and funding.

addition of some firmer funded programs such as BUILD/TECH

new construction as expected from the proposed T24

“Firm commitments”

Proposal for 2021 AAFS Development
Possible approach to Scenarios

Questions:

- **What thoughts do you have about which elements are more or less certain?**
- **Are there planning and procurement purposes where including more uncertain FS elements may be appropriate?**

Proposal for 2021 AAFS Development **Consideration of which AAFS & AAEE Scenario's are compatible**

- Need to consider which combinations of AAEE/AAFS scenarios are compatible with each other given total gas displacement potential and program funding sources.
- What quantifications need to be made to remove program double counting?
  - Currently choose the AAEE Scenario first and give the baseline gas consumption forecast a "haircut" as part of designing an FSSAT scenario FS is only allowed for the remaining gas consumption after AAEE reduction.
    - Pro: aligned with loading order
    - Con: "low hanging fruit" may be better suited for FS than gas EE

Proposal for 2021 AAFS Development **Consideration of which AAFS & AAEE Scenario's are compatible**

- Could one consider approaching this by designing gas AAEE and electric AAEE scenarios separately…?
  - Would allow for pairing of a low gas AAEE with a high electric AAEE and a moderate AAFS scenario for example.
  - Would this separation of AAEE be technically feasible given interactive effects from any increased EE in electric devices emitting waste heat (ex. Lighting)? Ie. Are the effects small enough to neglect (1-2%)?

- Any other pitfalls to avoid or items to consider here?

Proposal for 2021 AAFS Development **Consideration of who will use 2021 AAFS and for what purpose**

- By adding AAFS, we will need to revisit our common set forecasting agreement language after it has been determined what agencies want for what purpose.

Questions

- **What types of scenarios would agencies be interested in developing?**
- **What type of scenario should be used for the single forecast set?**
  - Rationale for using more one case for local studies vs. another case for system studies
- **What, if anything, would agencies utilize the more aggressive/optimistic scenarios for?**

Timeline

- **August 5:**
  IEPR Workshop Demand Forecast Inputs and Assumptions

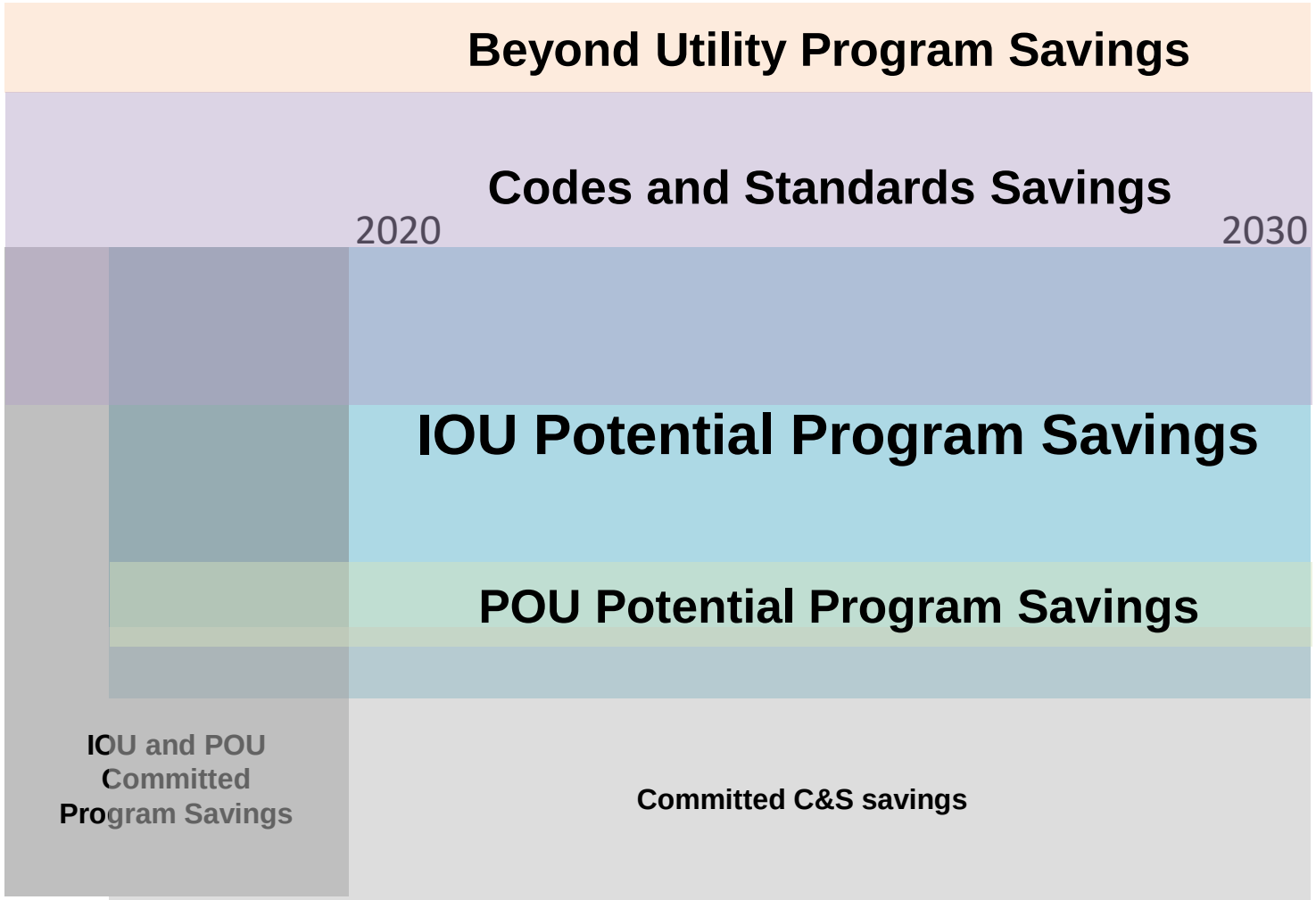
- **Late August:**
  DAWG AAEE & AAFS Preliminary Scenario Designs

- **Late September:**
  DAWG AAEE & AAFS Preliminary Scenario Results

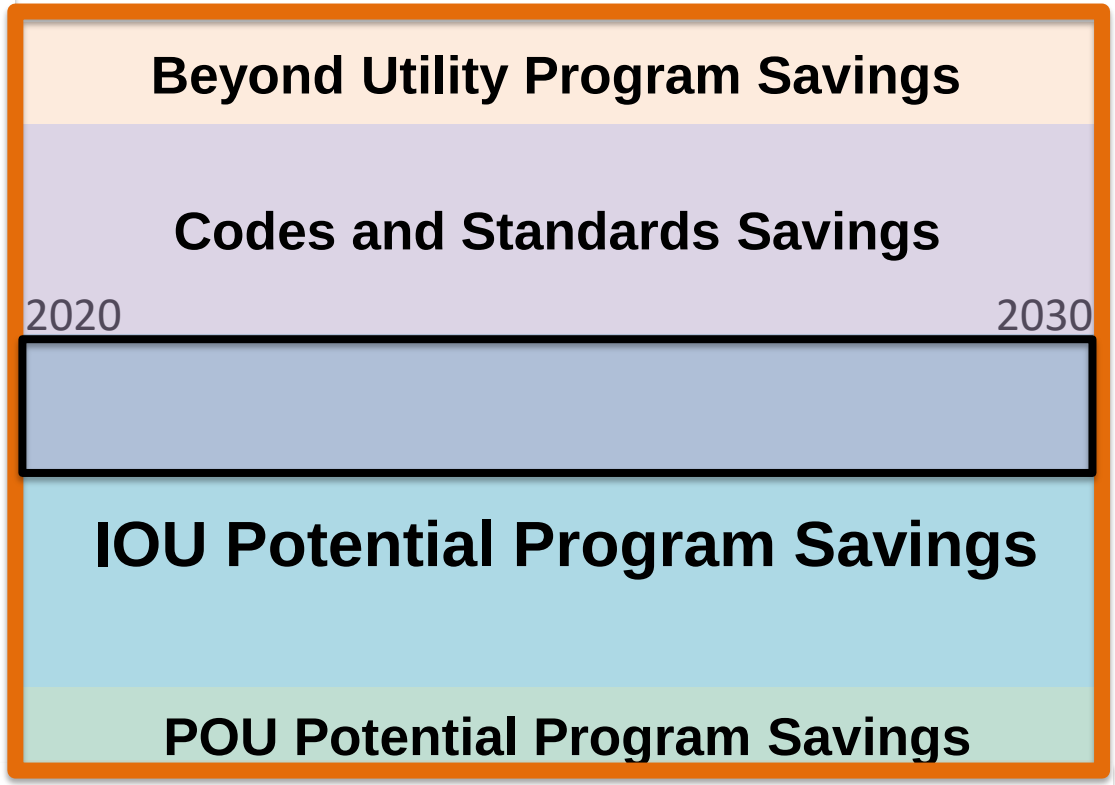
- **Early to mid December: IEPR WS to share Final Results of Managed Forecast including AAEE & AAFS modifiers**

Extra Slides “Appendix”

Additional Achievable Energy Efficiency (AAEE)
2019 Scenario Design



Additional Achievable Energy Efficiency (AAEE)
2019 Scenario Design



- eliminate duplication with baseline forecast

- eliminate any other duplication between savings streams

IOU AAEE Scenario Design

Lever	High - Low (Scenario 1)	Mid - Low (Scenario 2)	Mid - Mid (Scenario 3)	Mid - High (Scenario 4)	Low - High (Scenario 5)	Mid - High Plus (Scenario 6)
Building Stock	2017 IEPR High-Case	2017 IEPR Mid-Case	**2017 IEPR Mid-Case**	2017 IEPR Mid-Case	2017 IEPR Low-Case	2017 IEPR Mid-Case
Retail Prices						
AIMS ETs	Reference		**Reference**	Average of Reference & Aggressive		Aggressive
Incentive Levels	capped at 25% of incremental cost	capped at 50% of incremental cost	**capped at 50% of incremental cost**	capped at 50% of incremental cost		capped at 75% of incremental cost
C-E Measure Screening Threshold (TRC using 2019 Avoided Costs)	1.25		**1**	0.85		0.65
Marketing & Outreach	Default calibrated value		**Default calibrated value**	Increased marketing strength		
Financing Programs	No modeled impacts		**No modeled impacts**	IOU financing programs broadly available to Res and Com		
Low Income	PG Study Result Unchanged		**PG Study Result Unchanged**	PG Study Result Unchanged		
BROs Program Assumptions	Reference		**Reference**	Average of Reference & Aggressive		Aggressive

- Goal was to design a spread of IOU Program AAEE Scenarios from conservative to optimistic

POU AAEE Scenario Design

Lever	High - Low (Scenario 1)	Mid - Low (Scenario 2)	Mid - Mid (Scenario 3)	Mid - High (Scenario 4)	Low - High (Scenario 5)	Mid - High Plus (Scenario 6)
Expand Measure List	Reference		Reference	Add new measures		
Incentive Level	Reference x 75%			Reference		
Promotional Expenditures				Reference x 125%		
Behavioral Programs	Remove newly planned BROs			Reference		
Early Retirement Programs	Reference			Implement ER Programs		
Net to Gross	IOU					
Re-participation Rates						

- Goal was to design a spread of POU Program AAEE Scenarios from conservative to optimistic

Code and Standards Scenario Design

Lever		High - Low (Scenario 1)	Mid - Low (Scenario 2)	Mid - Mid (Scenario 3)	Mid - High (Scenario 4)	Low - High (Scenario 5)	Mid - High Plus (Scenario 6)
Title 24	Compliance Reduction or Enhancement	no additional induded	20% Compliance Rate Reduction	**Reference Case Compliance**	Compliance Enhancements		
	Code Cycles (Vintages)		2022 Nonresidential New Construction and A&A; 2022 Residential A&A *BUWB*			same scope through 2025 Standards *BU WB*	same scope through 2028 Standards *BU WB*
Title 20	Compliance Reduction or Enhancement	no additional induded	20% Compliance Rate Reduction	**Reference Case Compliance**	Compliance Enhancements		
	Code Cycles (Vintages)		~~Selected Stds. Through 2022 *PG Study*~~	~~**Selected Stds. Through 2022** *PG Study*~~	Selected Stds. Through 2022 *PG Study* & BUWB	Selected Stds. Through 2027 *PG Study* & BUWB	Selected Stds. Through 2029 *PG Study* & BUWB
Federal Standards	Compliance Reduction or Enhancement	no additional included		**Reference Case Compliance**	Compliance Enhancements		
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- statewide savings are allocated to each IOU, IRP POU or smaller POU grouping
  - *essential for the small POU's inside CAISO planning area*

Beyond Utility AAEE Scenario Design

<table>
<tr><th>Program Savings Scenario</th><th>High - Low (Scenario 1)</th><th>Mid - Low (Scenario 2)</th><th>Mid - Mid (Scenario 3)</th><th>Mid - High (Scenario 4)</th><th>Low - High (Scenario 5)</th><th>Mid - High Plus (Scenario 6)</th></tr>
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</table>

- Program specific levers are adjusted within each Beyond Utility program workbook and are grouped to define low, mid and high **BU AAEE Scenarios**.

Proposal for 2021 AAFS Development
Possible approach to Scenarios

Preliminary Thoughts on what could go into a hypothetical set of AAFS scenarios 1-6 ranging from most conservative to most aggressive or optimistic

1. "Firm commitments" including only anticipated all electric new construction due to currently existing local ordinances, new construction and existing Utility programs with compliance rates, participation, and funding ratcheted down from standard values.
2. The above plus all electric new construction as expected form the proposed T24 encouraging electrification.
3. The above using standard values for compliance rates, participation, and funding plus some firmer pending programs such as BUILD/TECH.
4. The above at a ratchet up from standard values for compliance rates, participation, and funding.
5. A scenario which include the above and adds more speculative programs in order to meet minimum AB 3232 goals for the Residential and Commercial Sector.
6. A scenario which includes the above and expands speculative programs further to meet economywide mid-century GHG reduction goals.